United States Participation in the 2011 Cooperative Indian Ocean Field Experiment

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Endorsed by the US CLIVAR MJO Working Group

Background I: Importance of the MJO/TIV

- Monsoons, ENSO, IODZM, ITF
- Teleconnections, extratropical circulation/weather
- Extreme events (midlat rainfall, tropical storm/cyclones)
- Earth's rotation rate, length of the day
- Atmospheric and oceanic chemistry and biosystem (ozone, CO_2, aerosols, chlorophyll)
- Prediction potential (> 20 days)

Background II: Challenges

- limited intraseasonal dynamical prediction skill (< 10 days)
- inability to consistently/knowlingly reproduce the MJO/TIV by global climate models
- poor understanding of the mechanisms for the MJO/TIV, especially their convective initiation
- lack of in situ observations in the equatorial Indian Ocean

Background III: MJO/TIV research recommended by

- THORPEX International Science Plan
- ECMWF, WCRP/THORPEX & US CLIVAR workshops
- Year of Tropical Convection (YOTC)
- US Climate Change Science Program (Synthesis and Assessment Product 3.3 “Weather and Climate Extreme in a Changing Climate”).

Scientific Rationale

• Convective initiation of the MJO/TIV is the least understood relative to propagation and its prediction more limited;

• Hypothesis testing (see white paper) requires continuous time series of vertical structures of convective systems and heat/moisture budgets – *available only from field campaigns*;

• No such time series from the equatorial Indian Ocean is available to date.

JAMSTEC commitment and international interests

• R/V MIRAI: ~ 50 days between Nov. 2011 – Jan. 1012

• seeking international participation

• international interests: Australia, US, China, India, France

Pressure-Longitude Diagrams of Temperature Anomaly Along Equator for the MJO

TRMM Rainfall Anomaly Shown as Line Plot (right axis); Panels Separated by 10 Days

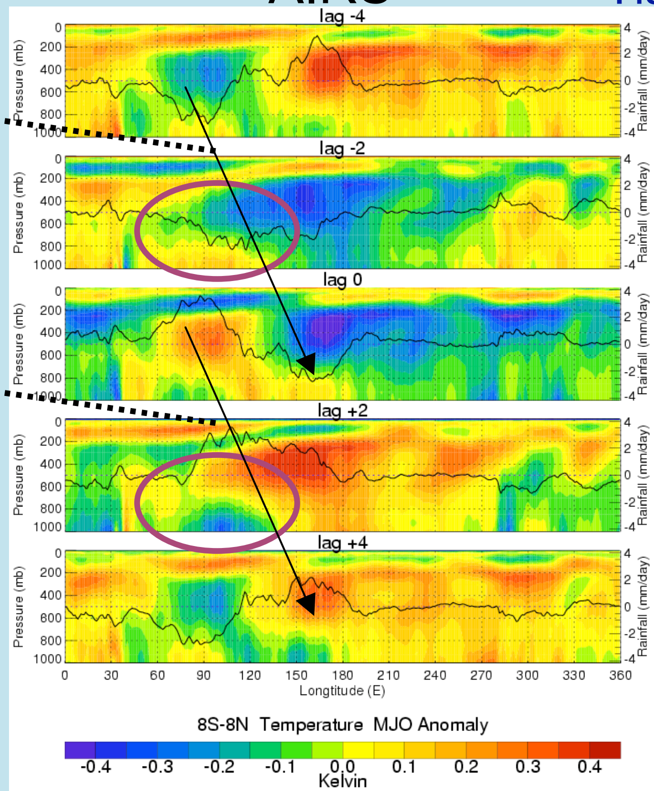
AIRS

Tian et al. 2006

NCEP/NCAR

Eastward propagation of “dry” phase

Eastward propagation of “wet” phase



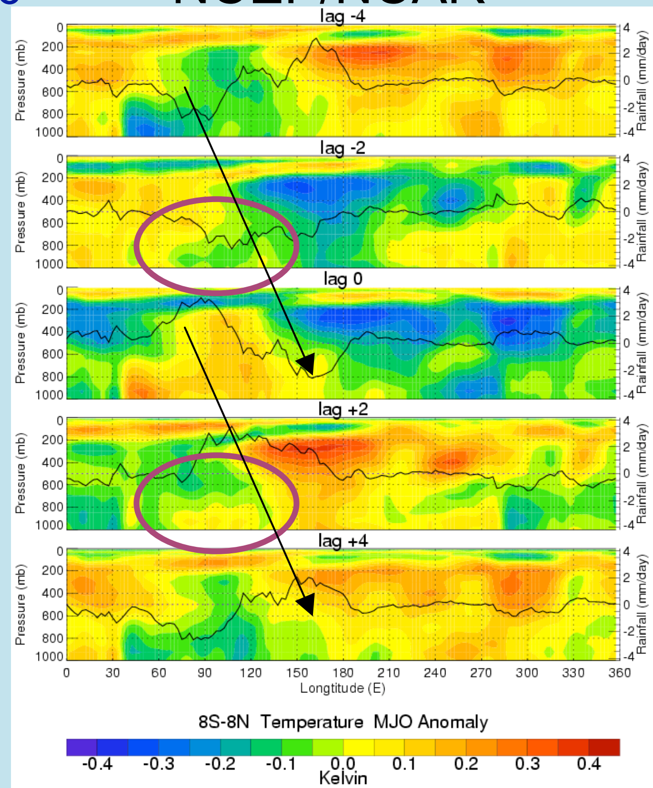
-20 Days

-10 Days

0 Days

+10 Days

+20 Days

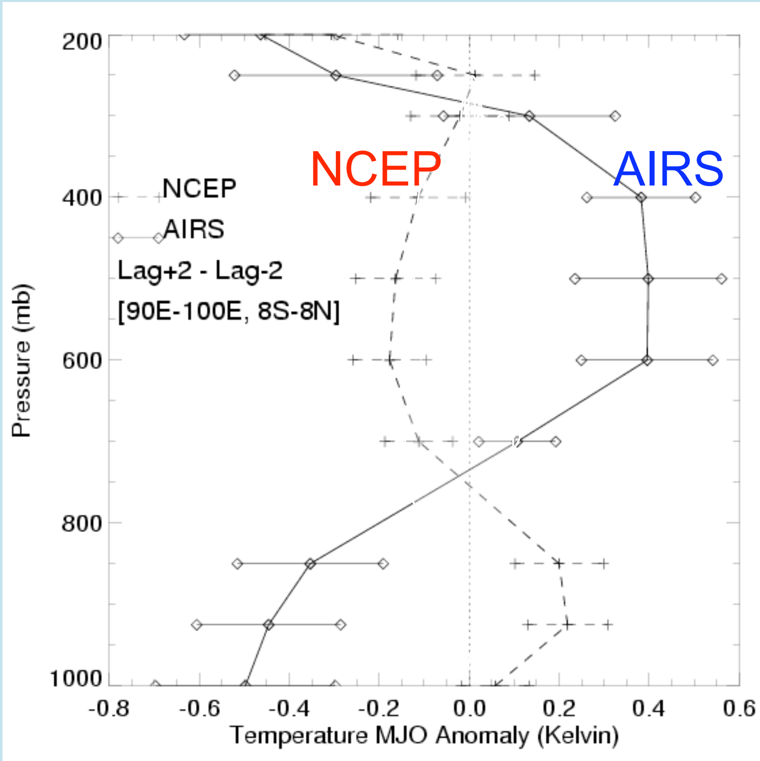


- The plots above are composite MJO structures based on 8 NH winter events.
- The ovals - over the Indian Ocean - highlight important differences between AIRS and NCEP/NCAR vertical temperature structure. <u>This difference is shown more concisely in the next slide.</u>
- In AIRS, a boundary-layer temperature anomaly precedes the tropospheric temperature anomaly in a somewhat consistent way for both the Indian and western Pacific Ocean. This doesn’t appear to be the case for the NCEP/NCAR results.

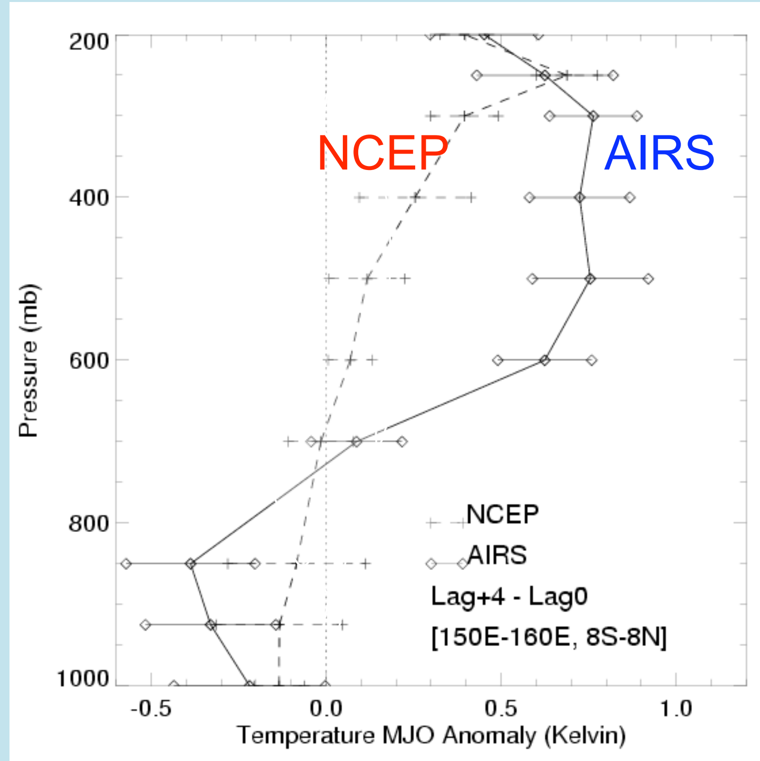
Vertical Profiles of Temperature Anomaly In the Indian & W.Pacific Ocean for the MJO

Tian et al. 2006

Indian



Western Pacific Ocean



- The above temperature profiles were taken from the composite AIRS and NCEP/NCAR MJO structures shown on the previous slide.
- The plot on the left shows the profiles over the Indian Ocean for Lag + 2 pentads (*disturbed*) minus Lag -2 pentads (*suppressed*). The NCEP/NCAR profile is less consistent with the implied conditions - i.e. positive precipitation anomalies.
- The plot on the right shows the profiles over the western Pacific Ocean for Lag +4 pentads (*disturbed*) - Lag 0 pentads (*suppressed*). The AIRS data exhibit stronger boundary-layer (tropospheric) cooling (warming) compared to the NCEP/NCAR for the implied conditions - i.e. positive precipitation anomalies.

Motivation and justification for the US participation

• Benefit from improved intraseasonal-seasonal prediction (hurricanes, North American Monsoon, ENSO, mid-latitude teleconnections & their extreme weather events);

• An additional research vessel with Doppler radar capability (e.g., R/V Ron Brown) essential to the data collection – record length (up to 100 days) and constraint for the budget estimates – *only available from the US*.

US facilities requested:

Primary:

• A research vessel with Doppler radar capability (preferably R/V Ron Brown) for 50 days on station to rotate with R/V MIRAI

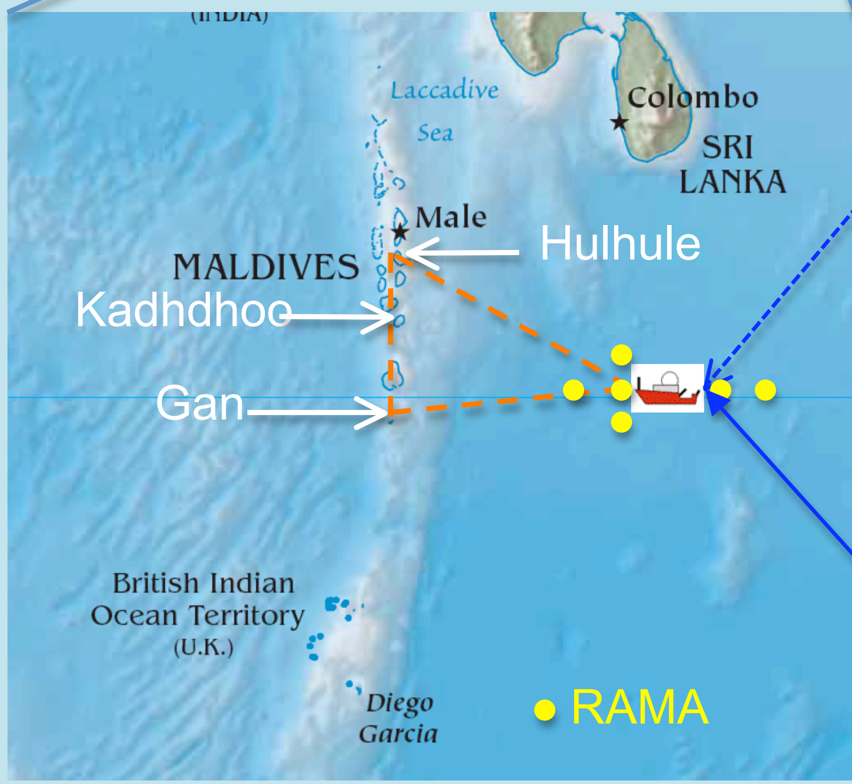
• soundings (≥ 4/day), air-sea flux and upper ocean measurement

Others (to be specified):

• Enhancement of RAMA

• measurement onboard of the research vessel for satellite validation, aerosols, etc.

A Preliminary Plan for the 2011 Indian Ocean Field Experiment



R/V Ron Brown

R/V MIRAI